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LIFE HISTORY OF THE LACEBUG, *CORYTHUCHA MORRILLI* OSBORN AND DRAKE, ON THE RAGWEED, *AMBROSIA DUMOSA* (GRAY) PAYNE, IN SOUTHERN CALIFORNIA (HEMIPTERA-HETEROPTERA: TINGIDAE)

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Corythucha morrilli is common on ragweeds in southern California (Goeden and Ricker, 1974, 1975, 1976a, 1976b, 1976c). Its biology was known only from limited observations on *Baccharis pilularis* Decandolle by Tilden (1950) when we began this study in 1976. Coincidentally, its laboratory biology concurrently was studied on sunflower (*Helianthus annuus* L.) in Texas by Rogers (1977). Its life history on the native, perennial desert ragweed, *Ambrosia dumosa,* in southern California is reported herein.

Taxonomy.—The adult was described in brief by Osborn and Drake (1917). Rogers (1977) reported head capsule measurements from nymphal exuviae and adults.

Distribution and host plants.—Drake and Ruhoff (1965) described this lacebug as ". . . a native of the southwestern United States, Mexico, Central America, and the West Indies." They also listed 15 host plants of *C. morrilli,* all but 1 of which are Compositae.

The junior author and D. W. Ricker collected adults and nymphs of *C. morrilli* during 1968–1972 from either *A. acanthicarpa* Hooker, *A. confertiflora* Decandolle, *A. dumosa, A. eriocentra* (Gray) Payne, *A. ilicifolia* (Gray) Payne, *A. psilostachya* Decandolle, or *A. pumila* (Nuttall) Gray at the following locations in southern California: Imperial Co.—Niland, Ocotillo, Picacho, Signal Mountain; Los Angeles Co.— Arcadia, Hollywood, LaVerne, Little Rock, Llano, Long Beach, Pasadena, Valyermo; Riverside Co.—Aguanga, Anza, Banning, Beaumont, Corn Spring, Desert Center, Elsinore, Hemet, Indio, Lake Hemet, Palm Desert, Palm Springs, Perris, Riverside, Sage, San Jacinto, Thermal, Twin Pines, West Palm Springs Village, Wildomar; San Bernardino Co.—Apple Valley, Cajon Junction, Cedar Canyon, Clarks Pass, Cucamonga, East Highlands, Forest Home, Hackberry Mountain, Halloran Springs, Lake Arrowhead, Mill Creek Park, Mountain Pass, Twenty-nine Palms, Yucca Valley; San Diego Co.—Alpine, Banner, Barrett Junction, Borrego Springs, Boulevard, Campo, Jacumba, La Mesa, Lyons Peak, Oak Grove, Otay, Pala, Pine Valley, Rainbow, San Felipi, Valley Center, Warner Springs; Santa Barbara Co.—Refugio Canyon, Santa Barbara; Ventura Co.—Fillmore, Port Hueneme, and Ventura.

Nymphs and adults also commonly were observed on brittle-bush, *Encelia farinosa* Gray ex Torrey.

Biology.—Field populations were studied at a site 8 km northwest of Palm Springs. Laboratory and insectary studies were conducted at Riverside. Insectary cultures were maintained on potted *A. dumosa* in the insectary at 27 ± 1°C, 45–60% relative humidity, and a 12/12-hr (light/dark) photoperiod.

Egg.—The mean (± S.D.) dimensions of 10 eggs were: length, 0.41 ± 0.03 mm; width, 0.16 ± 0.03 mm; diameter of operculum, 0.10 ± 0.03 mm. The egg is mostly light tan and flask-shaped, with a distinct, brownish operculum.

Eggs were embedded singly or in loose groups of 2–14 in the leaves and occasionally in the terminal branches and involucres of *A. dumosa*. The opercular end was exposed and stained brown with feces during oviposition. Of 1147 eggs observed in the insectary, 709 (62%) were laid in the upper leaf surfaces. Rogers (1977) similarly found two-thirds of the eggs in the adaxial surfaces of sunflower leaves.

Eggs hatched in 7–9 days in the insectary. Eclosion by 13 individuals averaged 17 min. (range: 9–25 min.). Sixteen individuals hatched within a 40-min. interval from 18 eggs deposited on 1 leaf by 1 female. Several nymphs were observed to retain the operculum atop their head until the first moult.

Nymph.—There are five instars (Rogers, 1977). Ten each, first–fifth instars averaged 0.32 ± 0.06 mm, 0.63 ± 0.04 mm, 0.96 ± 0.09 mm, 1.11 ± 0.10 mm, and 1.77 ± 0.13 mm in length, respectively; 0.16 ± 0.03 mm, 0.33 ± 0.02 mm, 0.53 ± 0.06 mm, 0.63 ± 0.08 mm, and 1.00 ± 0.07 mm in greatest width, respectively. The first instar was pale tan at eclosion, assumed a greenish tint after feeding began, and turned light brown by the first moult.

Most first instars fed gregariously on the undersides of leaves, commonly along the midribs and leaf margins, although the latter preferences were not strongly pronounced. They moulted throughout the photophase and during the scotophase in the insectary. Ecdysis by 25 first instars was completed in an average of 9.5 (range: 6–14) min.

Second–fifth instars fed singly as well as in aggregations. Feeding symptoms included leaf chlorosis and foliage soiled with their dark, viscous, liquid feces. When their feeding areas became chlorotic, they migrated to new leaves. Older nymphs tended to feed less gregariously. Each of the first–fourth stadia of 50 individuals lasted 1–2 days; the fifth stadium, 2–3 days.

Adult.—Adults were less gregarious than nymphs. They most commonly were observed at rest, feeding on the upper surfaces of leaves. Their feed-

ing, as with the nymphs, resulted in chlorosis and fecal discoloration of foliage.

Mating was observed in the field throughout the year on different host plant species. In the insectary, adults mated during the photophase and scotophase. Mating began within 2 days after adult ecdysis. No courtship behavior was noted. During copulation, the male's body was oriented at approximately a right angle to the female's, with her hemelytra and abdomen situated laterally between the male's hemelytra and abdomen. Males were polygamous; females, polyandrous. In 4 instances, in the field, 2 males were observed attempting to mate simultaneously with the same female. The mean durations of 25 matings observed in the insectary was 74 (range: 41–127) min. All but 1 of 40 pairs observed mating in the field were located on an upper, rather than lower, leaf surface.

Females began ovipositing an average of 3 (range: 2–4) days after ecdysis in the insectary. This was considerably shorter than the 7.9–day, preovipositional period reported by Rogers (1977). A single egg was laid at each insertion of the ovipositor. Under insectary conditions, females often fed and oviposited simultaneously. Twenty females laid a mean total of 213 ± 72.2 (range: 42–326) eggs during their 25 ± 7.6 (range: 4–32)-day ovipositional periods. Based only on days when females oviposited, the daily totals varied from 1 to 19 eggs, and averaged 9.1 ± 3.8 eggs. Ovipositional rates declined towards the end of the ovipositional periods. In the insectary, 20 males lived an average of 32.6 ± 3.1 (range: 11–61) days; 20 fecund females, 32.0 ± 2.6 (range: 9–52) days. The egg-to-egg cycle was completed in 2 or 3 weeks in the insectary.

Seasonal history.—Corythucha morrilli is multivoltine in southern California; however, the number of annual generations is unknown and probably varies with the host-plant species and climatic zone involved. There is an overlapping of generations during reproduction and nymphs can be found on different ragweeds in different parts of southern California throughout the year. Nymphs as well as adults occurred on *A. dumosa* at Palm Springs from February–June during 1971, 1972, and 1977; whereas, largely only adults were collected in January during those same years. A few eggs also were observed at the study site in January, 1977, but it is not known whether these were viable, overwintering, or freshly laid. Tingidae are known to overwinter as eggs and imagos in temperate zones (Drake and Ruhoff, 1965).

Reproduction largely coincided withe resumption of vegetative growth and reproduction by *A. dumosa* following winter rainfall at Sonoran Desert locations, including our study site, where adults usually could be found in limited numbers on this ragweed at other times of the year. Nymphs also were found on *A. acanthicarpa* from June–October, 1969; on *A. confertiflora* from June–November, 1970; on *A. eriocentra* from May–September,

1970 and 1971; on *A. ilicifolia* from December–May, 1970 and 1971; and on *A. psilostachya* from January–December, 1968–1970. These periods coincided with periods of active vegetative growth and reproduction by these ragweeds in southern California.

Natural enemies.—*Geocoris* sp. (Hemiptera-Heteroptera: Lygaeidae) and *Nabis* sp. (Hemiptera-Heteroptera: Nabidae) were observed feeding on both nymphs and adults of *C. morrilli* at the study site. A spider, *Xysticus* sp. (Araneida: Thomisidae), also preyed on the nymphs and adults. No parasites of *C. morrilli* were reared or otherwise detected.

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